Attachment
Total Solar Irradiance and Spectral Solar Irradiance Sensor System for a 2018 NOAA/NASA Mission

1.0 OVERVIEW

A total solar irradiance and spectral solar irradiance sensor system is being planned to fly as a NOAA/NASA Joint Polar Satellite System (JPSS) mission in 2018. The mission would be designed to continue the collection of (1) total solar irradiance (TSI) and (2) spectral solar irradiance (SSI) data for the long-term climate record. The mission would extend the over 40 year record of solar irradiance from space by overlapping with the first NOAA/NASA JPSS solar irradiance mission to be launched in 2014. This mission contains the Total and Spectral Solar Irradiance Sensor (TSIS) from the Laboratory for Atmospheric and Space Physics of the University of Colorado. The TSI sensor collects high accuracy, high precision measurements of TSI to monitor changes in solar irradiance incident at the top of the Earth's atmosphere. The SSI sensor collects high accuracy, high precision measurements of solar radiation as a function of wavelength..

1.1 Science Objectives

The overall science objectives of the mission are to perform continued space measurements of TSI and SSI to determine the Sun's direct and indirect effects on Earth's climate, at current state-of-the-art accuracy and without a temporal gap with the previous TSI and SSI missions in the dataset, It is essential that there be no temporal gapto insure the continuity of this long-term climate data record.

1.1.1Total Solar Irradiance

Total Solar Irradiance (TSI), together with the Earth's emitted infrared and reflected solar radiation determines the radiative balance of the Earth and its radiative effective temperature. The climate of the Earth is directly affected by the balance between the intensity of the sun and the response of the atmosphere. Changes in solar irradiance and in the composition of the atmosphere can cause global climate change. Variability in solar irradiance is purely a natural phenomenon, while the composition of the atmosphere is strongly influenced by the byproducts of modern industrial societies. The fundamental requirement for the TSI sensor is to report precise and accurate daily measurements of the TSI at the Top of the Atmosphere (TOA) to continue the long-term climate record.

1.1.2 Solar Spectral Irradiance

Measurement of Solar Spectral Irradiance (SSI) is key to understanding the response of climate to solar variability because of the wavelength dependence of various processes in Earth's atmosphere and surface. These include: direct surface and lower atmosphere heating at near-ultraviolet and longer wavelengths; indirect processes through absorption of UV in the stratosphere and radiative and dynamical coupling with the troposphere. Although the greatest relative variability occurs in the ultraviolet (indirect), the greatest absolute variability occurs in mid visible (direct). Relative uncertainty in solar forcing since the start of the industrial age (mid-18th century) is very large and must be reduced in order to separate natural from anthropogenic radiative forcing. Knowledge of TOA spectral distribution of solar radiation is crucial in interpreting the highly spectrally dependent radiative processes in the atmosphere and at the surface.

1.2 TSI and SSI Sensor System Requirements

The following TSI and SSI Sensor System requirements apply to nominal operations, except where noted.

1.2.1 Basic Requirements

1.2.1.1 The TSI sensor shall be designed to collect Total Solar Irradiance (TSI) data over the entire solar spectrum at the TOA.

1.2.1.2 The SSI sensor shall be design to collect Spectral Solar Irradiance (SSI) over the solar spectrum from 200nm to 2400nm**.**

1.2.1.3 During normal operations, the TSI and SSI sensors shall be capable of operating continuously with data collected from the sensors during all portions of the orbit.

1.2.1.4 The TSI and SSI sensors shall be absolute radiometers with a system to reduce 1/f noise and an internal absolute calibration source capable of fully establishing the measurement scale.

1.2.1.5 The TSI and SSI sensors measurements must be traceable to the NIST standards, as well as to the SORCE TIM, Glory TIM and SORCE SIM instruments.

1.2.2 TSI Accuracy and Stability

1.2.2.1 The TSI sensor shall measure TSI to an absolute accuracy of 100 parts per million (ppm) (1σ) with noise less than or equal to 10 ppm (1σ), where 1 ppm equals 0.0001%.

1.2.2.2 The TSI sensor shall have long term stability better than or equal to 10 ppm (1σ) per year after data corrections in post-processing.

1.2.3 SSI Resolution, Accuracy and Stability

1.2.3.1 The SSI sensor shall measure SSI from 200 nm to 2400 nm with a spectral resolution of 2 nm at wavelengths less than 280 nm; 5 nm at wavelengths greater than 280 nm but less than 400 nm; and 45 nm at wavelengths greater than 400 nm..

1.2.3.2 The SSI sensor shall measure SSI from 200 nm to 2400 nm with an absolute accuracy of 0.2% with noise less than 100 ppm (1σ),

1.2.3.3 The SSI sensor shall have long term stability better than 0.05% (1σ) per year for wavelengths less than 400 nm; and 0.01% per year for wavelengths greater than 400 nm..

1.2.4 TSI and SSI sensors system

1.2.4.1 The TSI and SSI sensors system shall include a real-time command and telemetry capability to accommodate anomaly resolution through the spacecraft.

1.2.4.2 The TSI and SSI sensors system software shall have the capability to

disable or override automatically triggered functions that change the configuration or operational state of the instrument.

1.2.5 Reliability

1.2.5.1 The TSI and SSI sensors system shall be designed to operate for a period of 5 years and have a reliability of greater than .75 Ps .

1.2.6 Mechanical Characteristics

1.2.6.1 The total TSI and SSI sensors system mass, including all subsystems, shall not exceed 150 kg)

1.2.7 Electrical Characteristics

1.2.7.1 The total power consumed by the TSI and SSI sensors system in any mode shall not exceed 200 watts

1.2.8 Maintainability

1.2.8.1 The TSI and SSI sensors system shall have the ability to receive and process software uploads from the ground segment while on-orbit.

1.2.8.2 The TSI and SSI sensors system shall monitor internal health parameters and major external faults and autonomously configure to a safe state upon encountering such a fault.

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